Key Transforming Operators in the Mono Class (Part 2)

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Learning Objectives in this Part of the Lesson

- Recognize key Mono operators
  - Concurrency & scheduler operators
  - Transforming operators
    - Transform the values and/or types emitted by a Mono
      - e.g., flatMap() & flatMapMany()

Key Transforming Operators in the Mono Class

Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)

```
<R> Mono<R> flatMap
  (Function<? super T,
            ? extends Mono
              <? extends R>>
   transformer)
```

See projectreactor.io/docs/core/release/api/reactor/core/publisher/Mono.html#flatMap

Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)
    - The param is a function that dynamically binds a new Mono

```
<R> Mono<R> flatMap
   (Function<? super T,
             ? extends Mono
               <? extends R>>
    transformer)
```

Interface Function<T,R>

Type Parameters:

T - the type of the input to the function

R - the type of the result of the function

All Known Subinterfaces:

UnaryOperator<T>

See docs.oracle.com/javase/8/docs/api/java/util/function/Function.html

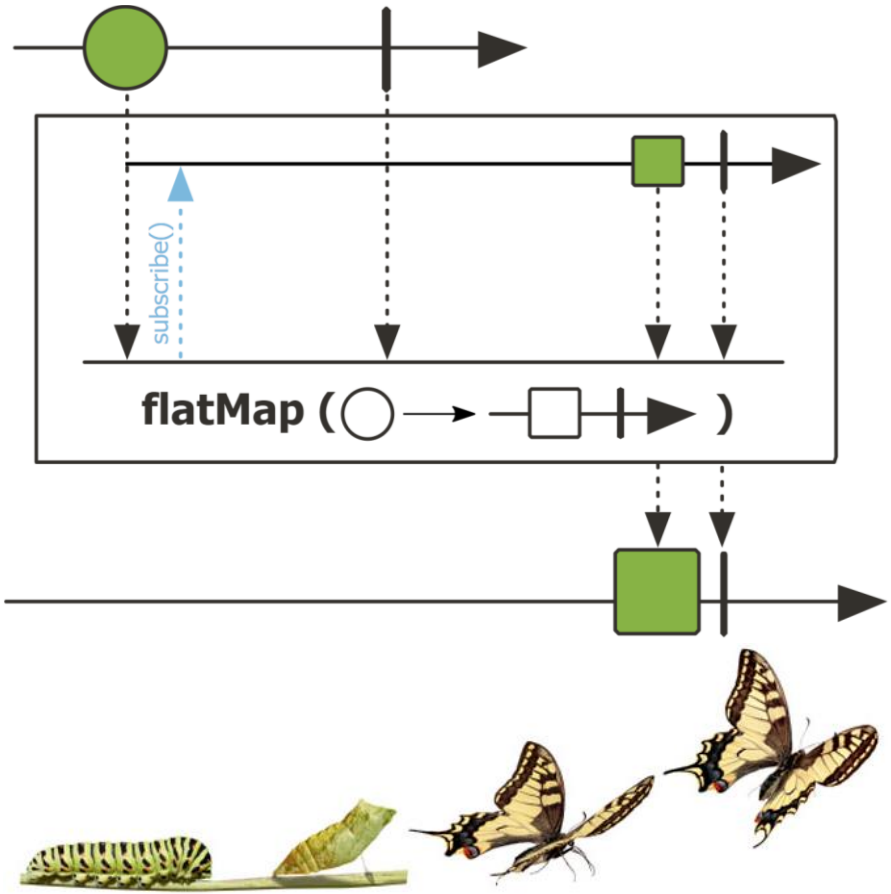
Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)
    - The param is a function that dynamically binds a new Mono
    - Returns the value emitted by the new Mono

```
<R> Mono<R> flatMap
   (Function<? super T,
             ? extends Mono
               <? extends R>>
    transformer)
```

Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)
  - Can transform the value and/or type of elements it processes



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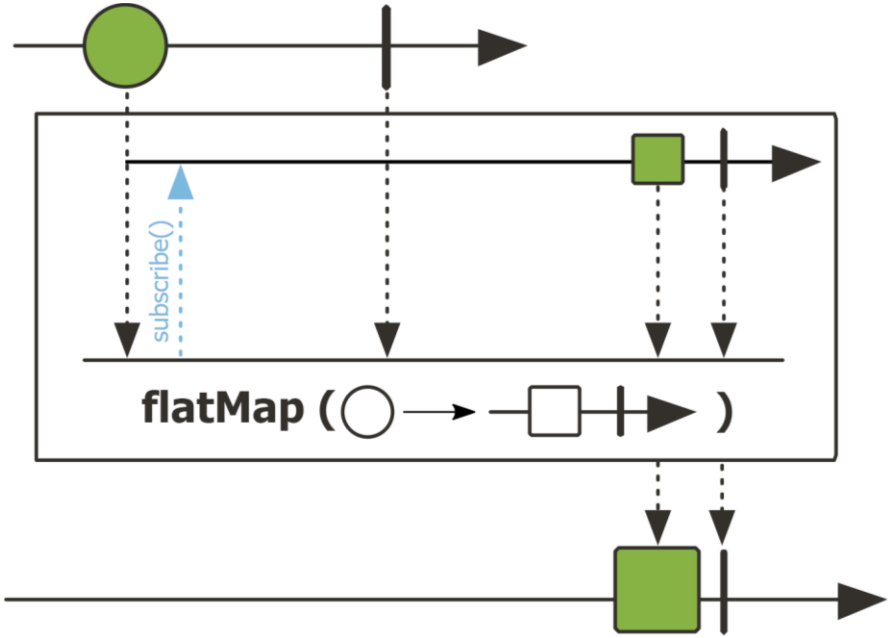


```
Mono<BigFraction> bfM1
   = makeBigFractionAsync(...);

Mono<BigFraction> bfM2 = bfM1
   .flatMap(bf ->
            multiplyAsync(bf, sBigReducedFraction))
```

Use flatMap() to asynchronously multiply a random BigFraction by a large constant & avoid "nested" monos

See Reactive/mono/ex3/src/main/java/MonoEx.java

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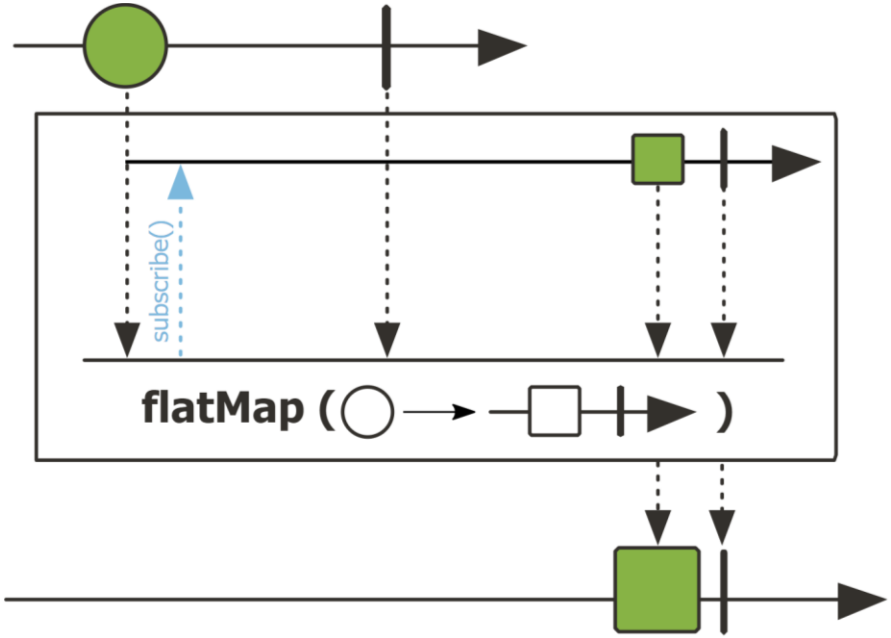


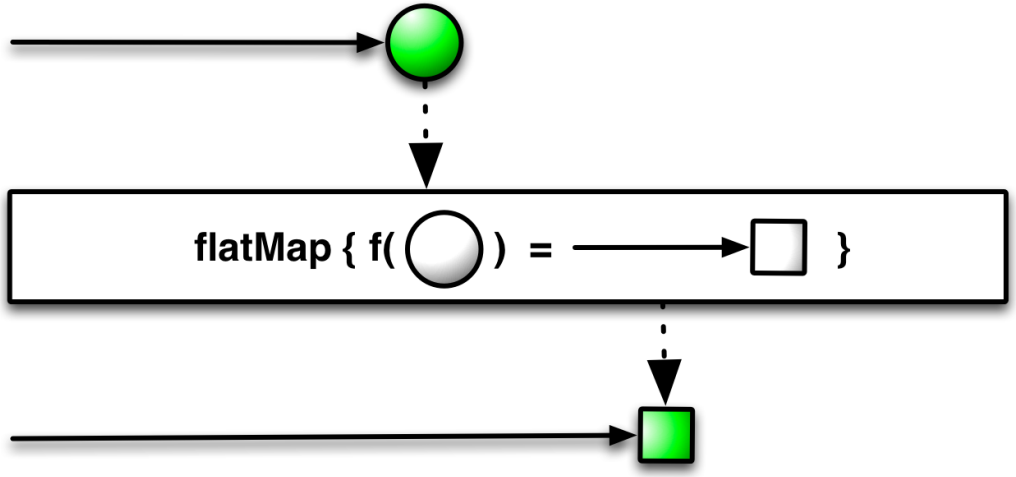

```
Mono<BigFraction> bfM1
  = makeBigFractionAsync(...);

Mono<Mono<BigFraction>> bfM2 =
  bfM1.map(bf ->
           multiplyAsync(bf, sBigReducedFraction))
```

This awkward nesting of Monos is needed if flatMap() were replaced by map()!

Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)
  - Can transform the value and/or type of elements it processes
  - RxJava's Single.flatMap() works the same way




```
Single<BigFraction> bfS1
  = makeBigFractionAsync(...);

Single<BigFraction> bfS2 = bfS1
  .flatMap(bf ->
           multiplyAsync(bf, sBigReducedFraction))
  ...
```

Asynchronously multiply a random BigFraction by a large constant

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Single.html#flatMap

Key Transforming Operators in the Mono Class

- The flatMap() method
  - Transform the item emitted by this Mono (asynchronously)
  - Can transform the value and/or type of elements it processes
  - RxJava's Single.flatMap() works the same way
- Similar to the thenCompose() method in Java Completable Futures

thenCompose

```
<U> CompletionStage<U> thenCompose(Function<? super T,? extends
CompletionStage<U>> fn)
```

Returns a new CompletionStage that is completed with the same value as the CompletionStage returned by the given function.

```
Function<BF,
         CompletableFuture<BF>>
  reduceAndMultiplyFractions =
    unreduced -> CompletableFuture
    .supplyAsync
      (() -> BF.reduce(unreduced))
    .thenCompose
      (reduced -> CompletableFuture
       .supplyAsync(() ->
        reduced.multiply(...)));
...
```

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#thenCompose

Key Transforming Operators in the Mono Class

- The flatMapMany() method
  - Transform the item emitted by this Mono into a Publisher

```
<R> Flux<R> flatMapMany
  (Function<? super T,
            ? extends Mono
              <? extends R>>
   transformer)
```

See projectreactor.io/docs/core/release/api/reactor/core/publisher/Mono.html#flatMapMany

Key Transforming Operators in the Mono Class

- The flatMapMany() method
  - Transform the item emitted by this Mono into a Publisher
    - The param is a function that produces a sequence of R

```
<R> Flux<R> flatMapMany
   (Function<? super T,
             ? extends Mono
               <? extends R>>
    transformer)
```

Interface Function<T,R>

Type Parameters:

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See docs.oracle.com/javase/8/docs/api/java/util/function/Function.html

Key Transforming Operators in the Mono Class

- The flatMapMany() method
  - Transform the item emitted by this Mono into a Publisher
    - The param is a function that produces a sequence of R
    - Returns a Flux that receives the emissions

```
<R> Flux<R> flatMapMany
   (Function<? super T,
             ? extends Mono
               <? extends R>>
    transformer)
```

Key Transforming Operators in the Mono Class

- The flatMapMany() method
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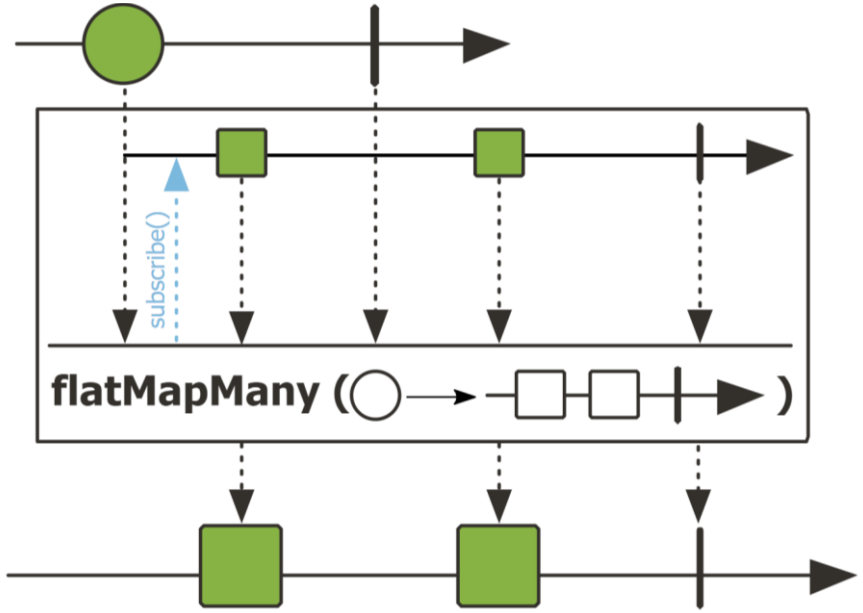

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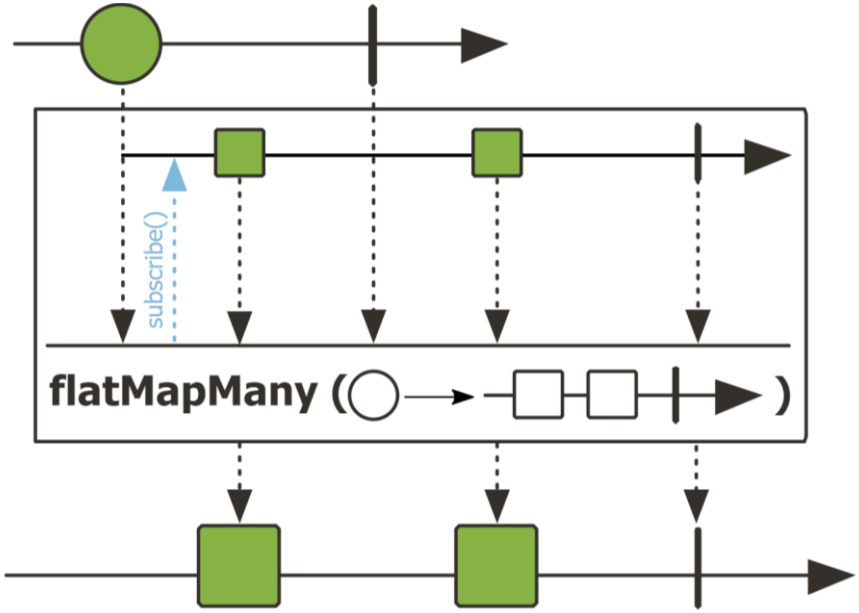


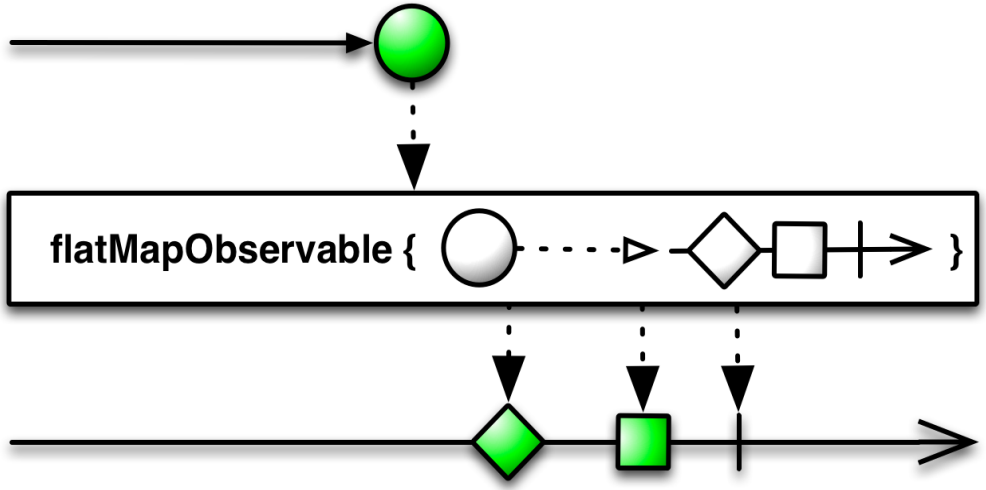

```
Flux<BigFraction> bfF =
  Flux.fromArray(...);
Mono<BigFraction> bfM =
  Mono.fromCallable(...);
bfM.flatMapMany(bf1 -> bfF
      .flatMap(bf2 -> Flux
                .just(bf2)
                .subscribeOn(Schedulers.parallel())
                .map(___ -> bf2.multiply(bf1))))...
```

Concurrently transform a Mono result into a Flux result

See Reactive/flux/ex4/src/main/java/FluxEx.java

Key Transforming Operators in the Mono Class

- The flatMapMany() method
  - Transform the item emitted by this Mono into a Publisher
  - Can transform the value and/or type of elements it processes
  - RxJava's flatMapObservable() method in Single is similar




```
Observable<BigFraction> bfO = Observable.fromArray(...);
Single<BigFraction> bfS = Single.fromCallable(...);
bfS.flatMapObservable(bf1 -> bfO.flatMap(bf2 -> Observable
                              .just(bf2)
                              .subscribeOn(Schedulers.computation())
                              .map(___ -> bf2.multiply(bf1))))...
```

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Single.html#flatMapObservable

End of Key Transforming Operators in the Mono Class (Part 2)